Public Recycling Program Costs and Efficiencies:

A Review and Analysis of Available Literature

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The Maine State Planning Office (MSPO), Waste Management & Recycling Program, is directed by statute to prepare an analysis of and a plan for the management, reduction and recycling of solid waste for the State, including related costs. To support and provide verification for MSPO's ongoing analysis of costs relating to solid waste management programs in Maine, the MSPO contracted with the Northeast Recycling Council (NERC) in 1998 to conduct a study that would provide a regional perspective to this effort.

This report was researched and written by Roddrick Aaron Colvin, (NERC) Intern, with assistance from Michael Alexander, NERC Program Manager. Lisa Baldwin and George MacDonald from the MSPO, Waste Management & Recycling Program, provided project direction and oversight.

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INTRODUCTION

This report considers variables that can influence the cost and efficiency for a recycling program as well as its participation, diversion and recovery rates.

This report has three inter-related goals. These goals are:

1. To provide municipal recycling coordinators a basis for making educated predictions as to the impact of individual program variables on overall program costs.

2. To summarize efforts that "test" various methods for improving cost savings, participation and recovery rates.

3. To introduce various options that could improve existing program performance but may not have yet been explored.

To accomplish these goals, a comprehensive literature review has been conducted. The initial review yielded over thirty variables that can potentially affect the performance and costs of a recycling program (See Appendix A). In consultation with the Maine State Planning Office - Waste Management and Recycling Program, several variables were selected for the scope of this report. The selected variables are:

- recovery method
- collection frequency
- recovered materials
- processor demographics
- materials processing
- education and promotion.

To accomplish goal 1 - provide municipal recycling coordinators a basis for making educated predictions as to the impact of program variables on overall program costs - this report examines actual communities and their experience with various program elements and provides information about the basic issues surrounding these variables and providing cost data for each.

To accomplish goal 2 - summarize efforts that test various methods for improving cost saving, participation and recovery rates – this report offers hypotheses for how changing these variables may impact recycling programs in the selected state of Maine. Based on field information, this report is especially helpful for communities using computer programs to improve their recycling efforts as the projected outcomes of a model can be compared to the actual outcomes of other communities around the country. Additionally, this report considers contextual issues, like community demographics and political implications.

To accomplish goal 3 - introduce communities to various recycling options that may not yet have been explored – this report addresses common issues that occur in the

literature by summarizing the best practices regarding each variable based on the experiences of communities around the nation.

DETERMINING SUCCESS

Throughout this report, several different measures of success will be encountered. Pferdehirt et al (1993) suggests that the following criteria were commonly used to gauge the performance of collection programs.

Participation Rate – Indicates the percentage of households eligible for pick-up that actually place recyclable materials out for collection. Many programs measure participation on a monthly basis.

Setout Rate – The percentage of households eligible for pick-up that setout materials on the specified collection day. The setout rate is less than the participation rate, because even active participants occasionally miss a collection date.

Recovery or Recycling Rate – Indicates the rate at which recyclable materials are recovered in each household, typically measured in pounds per household per month. This measure is a more significant indicator of performance than participation rate or setout rate, because the latter do not reflect how effectively participants are in recovering materials.

Diversion Rate – Measures the percentage reduction in waste sent to disposal facilities. This rate can be measured as a percent of the waste generated by the population served by the recycling program, the entire residential population, or by the entire communities' (commercial and residential) waste stream. This last measure may differ from the recycling rate, since materials may be diverted from the waste stream by other means than recycling.

LAYOUT OF THIS REPORT

For each of the variables explored, the basic layout of the chapter is the same. The reader will find:

- A definition of the variable
- Key questions to consider regarding the variable
- Programs, options and potential impacts of the variable
- Implications of the variable for the example State of Maine
- Cost implications of the variable
- A summary
- Resources for additional information

This consistent layout should help the reader to take as much information as possible from the report, while providing a design that enhances the use of the report as a reference document.

While this report can help administrators and coordinators improve their decision making process when considering the specific costs associated with recycling, it is not a comprehensive guide. Instead, this report addresses specific aspects of recycling that may or may not be applicable to individual communities. Since there are at least thirty variables additional to those from this report that can be considered when implementing or altering a recycling program, it is safe to say that there are thousands of combinations and endless potential outcomes for every community.

Communities are encouraged to make waste reduction and recycling a long-term process. There are no quick fixes or universal best practices for recycling programs. Recycling efforts should be viewed as dynamic, always growing and changing. Constant re-evaluation is the best practice. Communities that keep this in mind while reviewing this report will derive the most value from its content.

1 RECOVERY METHODS

1.1 DESCRIPTION OF THE VARIABLE

Recovery method refers to the manner in which recyclable materials are diverted from the waste stream. The two most common methods are drop-off services and curbside collection.

1.2 KEY QUESTIONS

What are the advantages and disadvantages of each recovery method? How does the recovery method affect program costs, participation and recovery rates?

1.3 PROGRAMS, OPTIONS AND POTENTIAL IMPACTS

Of all the variables considered, recovery method is probably most important. The method(s) employed to divert recyclable materials from the waste stream will determine the success or failure of the recycling program. Choosing the wrong method for a community will not only impede successful recovery of materials; it may limit future options for improving upon the recycling program.

Before considering the appropriate recovery method for your community, Goldstein et al (1990) suggests an assessment of the current waste and recyclable materials stream. The assessment should include:

- *Volume of regular refuse*
- *Anticipated volume of recyclable materials*
- *Number of households to be serviced*
- *Characteristics of the community (for example, percent of single family homes)*
- *Other recycling activities being planned (for example, local legislation or material bans)*
- *Refuse endpoints (for example, landfill space)*

The two most common recovery methods provided by communities are drop-off service and curbside collection of materials. Drop-off service refers to collection of recyclable materials that are taken to collection sites by residents and placed in designated containers. With curbside collection, recyclable materials are placed outside by residents and collected by designated haulers or collectors. Both types of service have advantages and disadvantages that should considered.

1.3.1 Drop-off Service

The common assumption is that drop-off services do not yield high participation, and thus there is low recovery. Goldstein et al (1990) suggests that drop-off programs have not been designed to encourage maximum participation or high recovery. Both Goldstein et al and Gies (1995) notes that several factors contribute to inefficient use of drop-off services, including lack of education and inconvenience. Goldstein et al

stresses that people must be educated about why and how to participate in a drop-off service. Of the communities studied by the EPA (1994), those that had the highest recovery rates used education as a key component of their recycling program.

In addition to education, drop-off services must be convenient for residents. While some communities locate drop-off services in conjunction with garbage drop-off facilities, many others site drop-off services wherever residents commonly travel. Examples include shopping malls and grocery stores. Communities choosing this option may incur additional transportation costs moving materials from the drop off location to the processing center. Wood (1996) suggests that other characteristics and program designs appear to be factors in diversion success. Wood notes five influential factors:

- Cleanliness
- Operation and layout
- Safety (for example, well lighted)
- Distance from home
- Convenience and access periods

Drop-off services are a cost-efficient way of collecting recyclable materials in rural areas and can also be used to augment curbside programs in suburban and urban areas. Wood (1996) finds no significant effect on diversion by combining drop-off services with curbside collection. In fact, such services can prove to be an appropriate outlet for residents who miss their curbside collection, will be out of town before their scheduled collection or want to recycle a unique material that is not collected at the curb.[1]

Generally, population densities need to be 40 – 50 persons per square mile or higher for curbside collection to be economically feasible (Pferdehirt et al, 1993, 64). As Pferdehirt et al (1993) suggests, areas with lower population densities might find drop-off services especially feasible and be able to achieve high participation and recovery with a well-designed service. Of the communities that the EPA (1994) studied, several of the suburban and rural areas were able to achieve high levels of both diversion and participation by operating drop-sites at landfills and transfer stations. Skumatz (1996) notes that the volume-based fee structures for garbage also encourage participation in this situation.[2]

In terms of costs, Wood (1996) compares several drop-off programs and finds varying costs among communities (see table 1.1).[3] The average cost of drop-off programs in this study was $62.20 per ton. While the cost range is quite large, Wood offers several interesting observations about these communities. Among these are the consistent diversion rates. Communities with successful drop-off programs seemed to all divert about the same amount of material (10 to 16 percent). Additionally, these communities serve similar numbers of people. About 2,600 people per drop-off site was the norm for communities with higher diversion rates.

Table 1.1 Communities with Drop-off Programs

Community	Type	Population	Number of Sites	Average Population Per Site	Diversion Rates	Costs Per Ton
Freeport, ME	**Private**	7,043	3	2,348	12.31	$102.66
Falmouth, ME	**Private**	7,610	2	3,805	13.55	$75.96
West Greenwich, RI	**Private**	2,749	1	2,749	9.73	$82.68
Blue Ash, OH	**Private**	13,629	6	2,272	10.79	$28.90
Largo, FL	**Public**	38,400	9	4,267	7.89	$26.07
Santa Monica, CA	Public	87,000	104	836	15.61	$56.92
AVERAGE PER TON COST						**$62.20**

Costs include Operation and Maintenance. Capital costs are excluded.
Figures have been re-calculated to 1999 dollars.
For more information, please see Wood (1996).

CASE STUDY OF DROP-OFF SERVICE

Town of West Greenwich, RI

West Greenwich launched a voluntary recycling program in 1989; a formal program in December 1990 and became mandatory in 1991.

Demographics
Population: 3750
Size: 51.2 square miles
1,316 single-family homes: no multi-family dwellings

Drop-off target area is comprised of 73 percent of the town's households that use the transfer station to dispose of trash and recyclable materials (about 961 households).

The Drop-off Facility
The Transfer Station serves as the only drop-off center.
The site accepts the following materials for recycling: newspaper, aluminum cans, foil and scrap, glass containers, plastic milk and soda bottles and tin (steel) cans.
Two people, during business hours (weekends and Wednesday nights during the summer) staff the drop-off center.

Program Costs
West Greenwich pays solid waste management costs out of property taxes. In FY, 1993, the spent $92,300 to manage solid waste. Of this, $13,459 ($11,459 Operation and Maintenance, $2,000 Education and Administration) was used to fund drop-off recycling.

Based on EPA (1995) Report 600-R-95-109

1.3.2 Curbside Collection

The literature suggests that curbside collection is the best method to achieve high levels of participation and recovery. Communities that achieve 40, 50 and 60 percent recovery rate, as well as 90 to 100 percent participation, all employ some type of curbside collection program (ILSR, 1991). Unfortunately, curbside collection is the most expensive component of a recycling program. Miller (1995) finds that as much as two thirds of the cost of a program can result from collection. The Department of Energy, in their case study review of six communities confirms this finding. The DOE found that collection costs, exclusive of transfer and haul expenses, ranged from 39 to 62 percent of the total system costs (1995, 6). Given the dominance of collection costs in recycling programs, attempting to balance the higher participation and recovery rates with the costs of collection is a challenge for every community.

There are several core issues that communities should consider, as well as a number of common best practices among curbside collection programs. In terms of core issues, Goldstein et al (1990) suggests that communities should consider:

- Assess market value for recyclable materials
- Consider each material to be collected
- Commingled collection versus separation in containers/bins
- Requirements on the part of residents
- Program format (design)
- Collection frequency
- Collection day
- Hours of collection and daily routing
- Type and size of containers
- Ownership of recyclable materials

Depending on the resources of the community, the level of involvement with the core issues will vary. For some communities, it is more cost effective to have contracts with recycling organizations and leave the details to the bidding firms. Some communities prefer greater involvement in the step-by-step process and use internal resources to address these core issues.[4]

Table 1.2 provides collection cost information from a number of US cities. Per ton collection costs ranged from $18.55 to $121.72, with the average collection cost at about $60 per ton.

Table 1.2 Costs for Curbside Collection of Recyclabes.

Community	Per Ton Collection Costs 1999 (Estimates)
Austin, TX	$93.90
Berlin Township, NJ	$25.50
Bowdoinham, ME	$26.66
Fennimore, WI	$53.33
La Crescent, MN	$78.83
Lincoln Park, NJ	$33.62
Lincoln, NE	$18.55
Monroe, WI	$57.96
Naperville, IL	$85.79
Newark, NJ	$66.08
Perkasie, PA	$51.01
Providence, RI	$121.72
Takoma Park, MD	$99.70
Upper Township, NJ	$75.35
West Palm Beach, FL	$60.28
AVERAGE COSTS/TON	**$57.97**

For more information, see Appendix B - Community Profiles or EPA (1994). Costs listed exclude processing, administration, educational, and capital costs. Figures have been re-calculated to 1999 dollars.

CASE STUDY OF COLLECTION SERVICE

Town of Longmeadow, MA

Demographics
Population: 16,309
Households: 5,744
Size: 9 square miles

Collection Information
Longmeadow has had a mandatory source-separation ordinance since 1984. The town has a municipal program that is operated under private contract.

The following materials are collected: newspaper, mixed paper (office paper, mail, magazines, and books) paperboard (egg cartons and cereal boxes), corrugated cardboard and leaves. Collection occurs weekly (newspaper and mixed paper one week, cardboard and paperboard the next week). Leaves are collected twice during November and December. With the exception of leaves, recyclable materials are picked up on the same day as refuse.

To collect materials, one person operates the packer for paper collection. Vacuum trucks are used to collect leaves, which residents leave loose at the curb.

Education consist of reminders in the newspaper and a free calendar/flyers (with collection days marked) distributed via grocery stores.

Program Costs
To collect 1,380 tons of recyclable materials in 1988, the Town of Longmeadow spent $73, 340 on collection. Additionally, the spent $450.00 on education and publicity.

In 1989, the community diverted 1,618 tons of recyclable materials and 2,666 tons of compost from the waste stream. Dividing the total, 4,284 by the total amount spent in 1989 give the cost per ton.

Longmeadow had no capital costs, since the equipment used belonged to the private contractor.

Based on ILRS Report (1991), Beyond 40 Percent.

Table 1.3 provides recycling program cost data from over 100 programs that were surveyed in 1989 and again in 1996 on the total costs of the programs. As the Folz (1999) points out, two important trends are important in these data. First, with the exception of cities in the smallest population group, many cities reduced their per ton recycling costs between 1989 and 1996. On average, the cost per ton declined by about 13 percent for all cities. Second, the mean recycling cost per ton in 1996 suggest that unit costs generally declined as city size and the number of tons recycled increases.

Table 1.3 Trends in Mean Tons Recycled/Composted and Mean Total Cost Per Ton in Constant 1992 Dollars by Population Size in 1989 and 1996.

Population	1989 Tons Recycled	1989 Cost/ton	N	1996 Tons Recycled	1996 Cost/ton	N	% Change Cost/ton
Under 5,000	636	$78.52	19	1536	$144.94	24	+84.58
5,000-10,000	637	$109.16	21	1493	$109.09	21	0.00
10,001-25,000	1837.44	$94.15	21	3097	$85.11	20	-9.60
25,001-50,000	3585	$90.19	13	11761	$44.08	11	-51.13
50,001-100,000	2176	$136.87	12	18509	$44.70	11	-67.34
Over 100,000	4304	$164.79	15	58718	$80.67	13	-51.05
All Cities	**1865**	**$109.18**	**101**	**12398**	**$94.96**	**100**	**-13.02**

Source: Folz (1999)

Best Practices

From the hundreds of different curbside collection programs, a number of best practices have been developed. The U.S. EPA (1994) notes that in order to achieve the highest participation and recovery rates, curbside collection programs have to be as convenient as possible. Programs that are successful:

- Provide weekly collection of recyclable materials, especially when weekly collection of refuse is provided.
- Offer services to all households - single family, multifamily, etc.
- Optimize set-out and collection methods - source separation, commingled, compacting vehicles, variable refuse rates, etc.
- Provide adequate containers for storage and set-out of recyclable materials.
- Establish recycling drop-off services, especially if residents self-haul.

Several of the best practices noted by the EPA's case studies were confirmed via the statistical work of Skumatz (1996). She found that program design, collection method, adequate containers and weekly collection could positively affect recovery and participation. Ligon et al (1996) finds that targeting a large portion of the residential waste stream has a significant affect on recovery rates.

1.4 IMPLICATIONS FOR MAINE

Selecting a method to recover recyclable materials is probably one of the most important decisions a community can make about recycling as the method(s) chosen will affect options for future improvements.

For urban communities with dense populations, curbside collection can yield high participation and recovery. Cost is somewhat lower since more material can be collected in a shorter amount of time. In such an environment, haulers spend more time actually picking up materials and less time driving and unloading the vehicle. The literature also suggests that drop-box service can be used to augment collection without affecting participation or recovery in a negative way.

Most suburban and rural communities have a number of options. For communities with refuse collection service, recyclable materials collection can be added with significant diversion, recovery and participation rates. In most cases, providers of refuse collection will consider also providing recyclable collection. In other cases, regional recycling efforts might make collection more economically feasible. Communities with some collection services may find that drop-off services complement their collection programs. For example, residents can use the drop-off services if they miss a collection day or have excess materials.

In communities where curbside collection is not feasible, drop-off services alone can serve as an efficient alternative. Many rural communities have been successful in implementing convenient drop-off services. Skumatz (1996) finds that even smaller communities (under 10,000) are able to realize the benefits of this type of service. In addition to the considerations offered previously, community cohesiveness, outreach issues and waste composition factors contribute to the success of rural and suburban drop-off efforts.

Regardless of the method of recovery, communities will need to consider the unique characteristics of their municipality. These will include consideration of the materials in their waste stream, type of housing, population density and community interest in recycling. It is important to remember that the service selected will need to be tailored to each community and that periodic assessments and changes are a natural part of a successful recycling program.

1.5 SUMMARY

- The method of recovery selected will affect future options available to communities.
- The two most common methods of recovery are drop-off service and curbside collection.
- Drop-off services can be an effective, low cost, option to divert materials from the waste stream.

- Convenience is the most important consideration for drop-off services.
- Curbside collection is the most effective method to ensure high participation and recovery rates.
- Curbside collection may not be feasible for low-density communities.
- Drop-off services and curbside collection should not be understood as "either/or" options. The two methods can be used to complement each other and increase participation and recovery.
- Municipalities will need to customize recovery methods to account for the uniqueness of their community.

1.6 FOR MORE INFORMATION ABOUT RECOVERY METHODS

Assman, D. *Making Recycling Collection More Effective*. Resource Recycling. September 1998.

EPA 530-R-92-015. *Waste Prevention, Recycling, and Composting Options: Lessons from 30 Communities* (Institute for Local Self Reliance). 1994.

Folz, D. *Municipal Recycling Performance: A Public Sector Environmental Success Story*. Public Administration Review. July/August 1999.

Gies, G. *Drop-off Recycling As A Low Cost Alternative*. Biocycle. March 1995.

Goldstein et al. *The Biocycle Guide to Collection, Processing and Marketing Recyclables*. Biocycle. 1990.

Ligon, P. Zuckerman, B. & Stutz, J. *Increasing Recovery Rates at the Curb*. Resource Recycling. February 1996.

Miller, C. *Recycling Efficiency: The Shape of Things to Come.* Waste Age. 1995.

Moore, P. *Cost Effective Collection of Recyclables*. Biocycle. July 1992.

Pferdehirt, W. et al. *Alternatives Methods for Collection of Residential Recyclables*. Waste Age. March 1993.

Platt, B. Doherty, A. Broughton, C. & Morris, D. *Beyond 40 Percent: Record-Setting Recycling and Composting Programs.* Institute for Local Self Reliance. 1991.

Skumatz Economic Research Associates, Inc (SERA). Nationwide Diversion Rate Study - *Quantitative Effects of Program Choices on Recycling and Green Waste Diversion: Beyond Case Studies.* 1996.

Stedge, G. Halstead, J. & Morris. *Alternative Approaches to Collecting Recyclables*. Biocycle. May 1993.

Wood, E. *Making Drop-off Recycling Work*. Resource Recycling. January 1996.

2 COLLECTION FREQUENCY

2.1 DESCRIPTION OF THE VARIABLE

Collection frequency refers to how often recyclable materials are picked-up at the curb. Collection frequency can range from twice a week, weekly, biweekly or monthly.

2.2 KEY QUESTIONS

How often should recyclable materials be collected? How does collection frequency influence participation and recovery rates? Should refuse and recyclable materials be collected on the same day? What are the cost implications for going from weekly to biweekly collection?

2.3 PROGRAMS, OPTIONS AND POTENTIAL IMPACTS

Collection frequency can affect overall program efficiency, participation rates and the quality of materials recovered, all of which have an influence on the cost of the recycling program. On the one hand, weekly collection of recyclable materials can increase participation and set-out rates, which should increase recovery of materials. On the other hand, weekly collection of materials may prompt citizens to set out containers that are not full. This will reduce the amount of materials collected per household, requiring collection vehicles to make more stops before filling up, thus decreasing collection efficiency and increasing costs.

2.3.1 Biweekly Collection Of Recyclable Materials

Biweekly (or monthly) collection of recyclable materials can reduce the most expensive aspect of residential curbside programs – that of actually collecting materials from the community. While reducing collection intervals can increase the amount of material per collection stop, it can also negatively affect participation and recovery rates. Residents may be less inclined to participate, , especially if residents believe that they may have to store the materials for a month if collection is missed. Furthermore, if recycling and refuse collections are not well coordinated, residents might be confused about collection of the two streams. Any reduction in participation will ultimately affect the amount of materials recovered.

The literature suggests that biweekly collection of recyclable materials can reduce the overall costs of a recycling program, but at the expense of participation and recovery. Those sources advocating biweekly collection stress that public education is a fundamental aspect of this approach (Block, 1997). Education and promotion programs will need to target at least three issues:

1. Options for missed collections or excess recyclable materials.

   Residents will need to know what they can do if they miss a biweekly collection day or if they have materials beyond their storage capacity. This might include drop-off options or rescheduled pickups.

2. Concerns about larger collection bins or bags (which may be of particular concern to senior citizens and the disabled).

   Since less collection will require residents to store materials for a longer period of time, storage capacity issues will need to be addressed and community education will need to be incorporated.

3. Distinction between refuse and recyclable materials collection.

   Kimrey (1996) suggests that an effective biweekly collection program can be developed if considerable attention is given to coordinating collection of refuse and recyclable materials.

   While several municipalities have implemented this strategy with noted cost savings, little data exist regarding the long-term effects of biweekly collection on participation and recovery rates.[5]

2.3.2 Weekly Collection Of Recyclable Materials

Weekly collection of recyclable materials is the most effective way to increase participation and recovery. The assumption that increased participation and set-out rates will increase recovery (and thus, efficiency) is confirmed via the literature. The U.S. EPA (1994) found that most programs with high participation and recovery rates have weekly collection of recyclable materials. Among their case studies of communities with both weekly and monthly collection of recyclable materials, neighborhoods with weekly collection have higher participation rates.

This increased participation and recovery is also observed in communities that switch from biweekly collection to weekly collection. For example, when the community of Naperville, IL switched from biweekly to weekly collection, overall monthly program participation increased from 54 percent to between 75 and 80 percent (EPA, 1994). When the participation increased, the community of Naperville also experienced an increase in recyclable materials collected. While servicing the same number of households and collecting the same types of recyclable materials, collection rose by 72 percent (EPA, 1994).

Other quantitative data also suggests that weekly collection of recyclable materials can generate these higher rates. The statistical analysis conducted by Skumatz (1996) finds that programs with higher recovery rates performed collection on a weekly basis,

rather than every other week or monthly. Furthermore, her work suggests that weekly collection could increase diversion by two to four percent.[6] Decisions about the additional costs and equipment needed for weekly collection should be measured against the potential benefits of more frequent pickups.

One community found the costs between weekly and biweekly collection to be similar. Huntington, New York studied the implications of switching from biweekly collection of recyclable materials to weekly collection. This community of 58,000 residents collected: commingled glass, metal, plastic containers, aluminum foil and plastic film, as well as mixed paper, magazines, corrugated containers, other paper board products and books. Two-person crews, in 25 cubic yard (non-compact) vehicles conducted collection. Since the current collection fleet was nearing the end of its life cycle, cost estimates were made assuming new equipment for both collection frequencies.

The costs per ton to collect materials weekly was $79.94 and the costs to collect the materials biweekly was $82.40 (see figure 2.1). These comparable costs suggest that weekly collections of materials can be conducted at a comparable cost. Communities may be able to gain the additional benefits of weekly recycling while maintaining existing levels of expenditure through more efficient use of personnel and equipment.

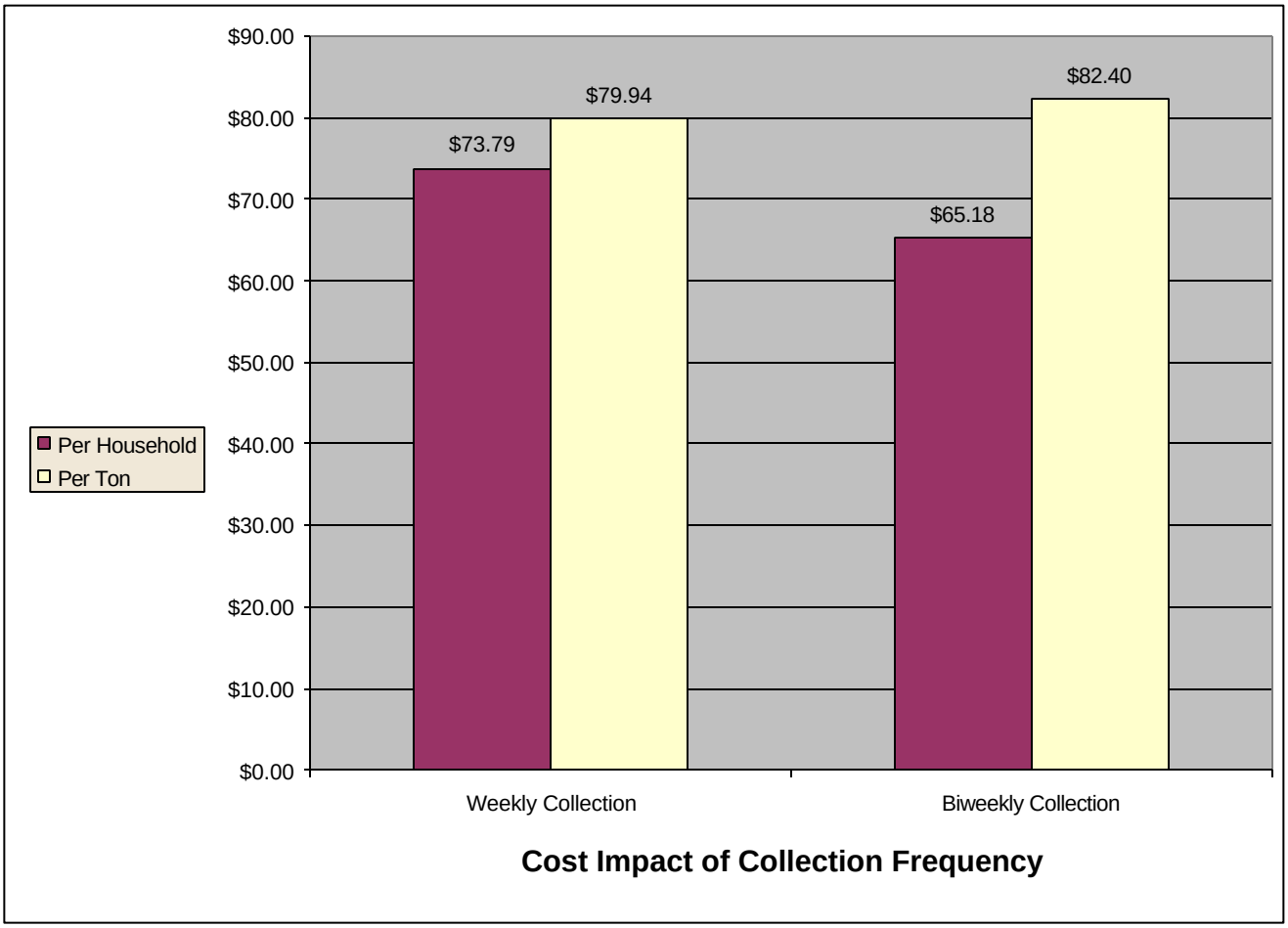
Assumptions

Costs are based on the purchase of all new collection equipment, regardless of the collection frequency. Huntington compared a two-way sort, using a 31 cubic yard vehicle, to the town's existing biweekly collection schedule using the 25 cubic yard vehicles.

Since weekly collection has been proven to increase recovery and participation rates, weekly collection costs assumes “moderate" recovery rates and the weekly collection costs assumes "high" recovery rates.

Source: Jacalone, D. Curbside Recycling Collection Variables. Resource Recycling, October 1992.

Figure 2. 1



*Figures reflect 1999 dollars.

2.3.3 Same Day Recyclable and Refuse Collection

Although Skumatz (1996) notes that about half of the programs sampled collect recyclable materials and refuse on the same day, neither the Skumatz report, nor the EPA (1994) study found a significant relationship between same day collection of recyclable materials and refuse. The EPA finds that, "collecting recyclable materials on the same day as refuse does not necessarily increase participation rates or recycling rates. Establishing a consistent recycling collection day and conducting an effective promotional program that instructs residents to set out recyclable materials on the designated day, appears to be more important than collecting recyclable materials on the same day as refuse" (1994, 50).

2.4 IMPLICATIONS FOR MAINE

Attention to collection frequency can affect efficiency, participation and recovery rates. Generally, communities can increase both participation and recovery rates with weekly collection services. However, in some communities, where diversion and participation

rates are high, biweekly collection might be more appropriate. This type of collection service should be combined with extensive community education about the designated collection days and options regarding missed pickups. Additionally, curbside containers may need to be changed to handle the additional materials that will be stored and collected.[7]

For many Maine communities, individual town decisions determine collection frequency. In communities where participation and recovery rates are of particular concern, efforts to change collection frequency might be worthwhile. As noted by Skumatz (1996), under weekly collection, recovery can increase as little as two percent or as much as four percent. Combined with other alterations, this amount of diversion could prove to be crucial for meeting state and local recycling goals.

In communities where participation and recovery rates are stable (and fairly high) but operation costs are an issue, biweekly collection might be a more appropriate option. Smaller communities with mandatory recycling or variable based rate structures could implement a biweekly collection as an effective approach towards reducing costs. Some resources should be redirected toward education and promotion of the new system, as well as issues of storage capacity of recyclable materials over the two-week period. As Skumatz notes, "some communities may find that every other week collection can lead to a more cost-effective program (and little costs in tonnage), and/or may free up budget resources to allow purchase of containers, or upgrade processing capabilities, etc." (1996, 23).

2.5 SUMMARY

- Weekly collection of recyclable materials can increase participation and recovery rates.

- Communities with significantly high participation and recovery rates in their curbside collection programs might be able to reduce costs by implementing biweekly collection.

- To be effective, education and promotion must accompany any changes in collection services.

- Collecting refuse and recyclable materials on the same day does not necessarily improve participation or recovery rates. However, both recyclable and refuse collection should be considered when developing overall collection strategies.

2.6 FOR MORE INFORMATION ON COLLECTION FREQUENCY

Anderson, P. *Improving the Efficiency of Curbside Recycling Collection*. Resource Recycling. April 1994.

Block, D. *Containing Collection Cost*. Biocycle. December 1997.

EPA530-R-92-015. *Waste Prevention, Recycling, and Composting Options: Lessons from 30 Communities* (with Institute for Local Self Reliance). 1994.

Grogan, P. *New Approaches to Lower Program Cost*. Biocycle. July 1992.

Kimrey, E. *Rethinking the Refuse Recycling Ratio*. Biocycle. July 1996.

Platt, B. Doherty, A. Broughton, C. & Morris, D. *Beyond 40 Percent: Record-Setting Recycling and Composting Programs*. Institute for Local Self Reliance. 1991.

Skumatz Economic Research Associates, Inc (SERA). Nationwide Diversion Rate Study - *Quantitative Effects of Program Choices on Recycling and Green Waste Diversion: Beyond Case Studies.* 1996.

3 RECOVERED MATERIALS

3.1 DESCRIPTION OF THE VARIABLE

Recovered materials refers to the diversion of certain (or target) materials from the waste stream for the purpose of recycling or composting. Materials can be recovered through drop-off, curbside collection or composting of organic materials.

3.2 KEY QUESTIONS

Which materials should a community divert? What are the effects and cost implications of diverting yard waste and mixed paper from the refuse steam? Are there other options beyond collection?

3.3 PROGRAMS, OPTIONS AND POTENTIAL IMPACTS

Determining the appropriate materials to divert from the waste stream can be more art than science. Many factors can influence a community's waste steam and the materials that can be diverted. These factors include: the demographics of the community, weather conditions, disposal costs, the availability and capacity of processing facilities, availability of markets, as well as the capacity of containers and/or collection vehicles.

Once materials are targeted for diversion from the waste stream, the most appropriate recycling practices have to be determined. Deciding that a material constitutes a significant portion of the waste stream does not automatically create the opportunity to divert the material. Communities will need to ask:

1. Can our current recycling programs handle additional materials?
2. Should some materials currently being diverted be discontinued?
3. How will this change affect participation and recovery?
4. Is there a viable market for the additional materials?
5. What other options exist to divert this material from the waste stream?

Considerable attention should be given to the composition of the current waste stream, as well as potential market outlets when deciding what materials should be targeted for recycling. In this respect, no two communities are alike and each community may find a different mix of materials to divert from their waste streams.

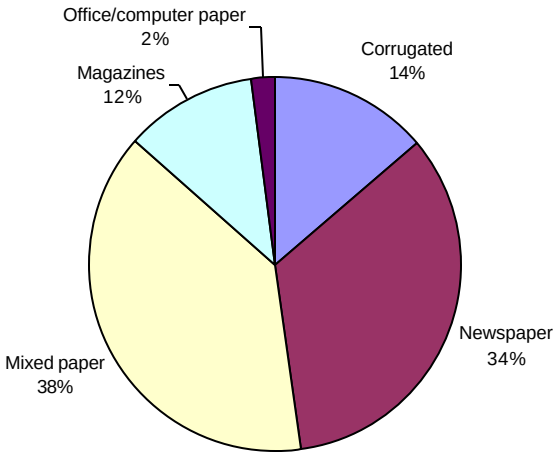
The literature suggests that communities with high recovery rates target a wide range of materials. These communities tend to target the basics: plastic, corrugated cardboard, glass, etc, but also target other materials based on their particular waste stream. These materials can include scrap metal (white goods, appliances, non-ferrous metals, and larger pieces of aluminum), mixed paper, yard waste and wood waste. ILSR (1991) found that communities were even able to increase recovery levels by targeting smaller

components of the waste stream such as tires, batteries, books and motor oil. Of the municipalities in the EPA study (1994), communities with the highest diversion rates (between 28 and 42 percent) targeted between five and 15 types of recyclable materials. Conversely, communities with the lowest recovery rates only targeted a limited number of materials. Because mixed paper and yard waste are two materials with the potential to significantly increase diversion rates when targeted for collection, these materials are examined in greater detail.

3.3.1 Mixed Paper Diversion

For many communities the decision whether or not to divert mixed paper is of particular concern. Paper can be the single largest component of the waste stream and account for the largest portion of residential recyclable materials. Gershman (1995) finds that the community of Montgomery County, Maryland had a waste stream that was comprised of 36.2 percent paper (mixed paper, newspaper, corrugated, magazines and office/computer paper), making it the largest single component of the stream. In some cases, paper can comprise as much as 50 to 80 percent - by weight - of the residential waste stream (ILRS, 1991, 60). When considering the many types of paper found in the waste stream (newspaper, high-grade paper, corrugated cardboard and mixed paper waste like advertising mail and magazines), it is easy to understand why targeting this material can have a dramatic effect on recovery rates.

Residential Waste Paper Stream - Montgomery Cty, MD - 1994



By removing additional sources of paper, beyond newspaper and cardboard, communities can significantly increase recovery and diversion rates. However, the literature suggests that this task can present challenges for many communities. For example, Tkach (1995) notes that when St. Paul, MN attempted to divert junk mail from the waste stream, it did not meet program expectations. After previous years of

education and information about paper sorting, the St. Paul communities found it difficult to accept that envelops with plastic windows and colored paper were now recyclable (1995, 66). Additionally, communities can encounter difficulty when trying to make changes in paper collection since the paper market can be quite volatile. This unpredictability makes determining the effectiveness and efficiency of diverting additional paper materials more difficult. Some communities divert a wide range of mixed paper and manage the short-term market volatility with long-term considerations such as long-term contracts with fixed returns.

Field experience suggests a significant addition to recovery and diversion rates when mixed paper is added to existing recycling programs. Skumatz (1996) states that the most common change in recycling programs is the addition of mixed paper and plastic (PET and HDPE). Since targeting mixed paper can significantly increase diversion, communities have the potential to dramatically affect their recycling programs by such an addition.

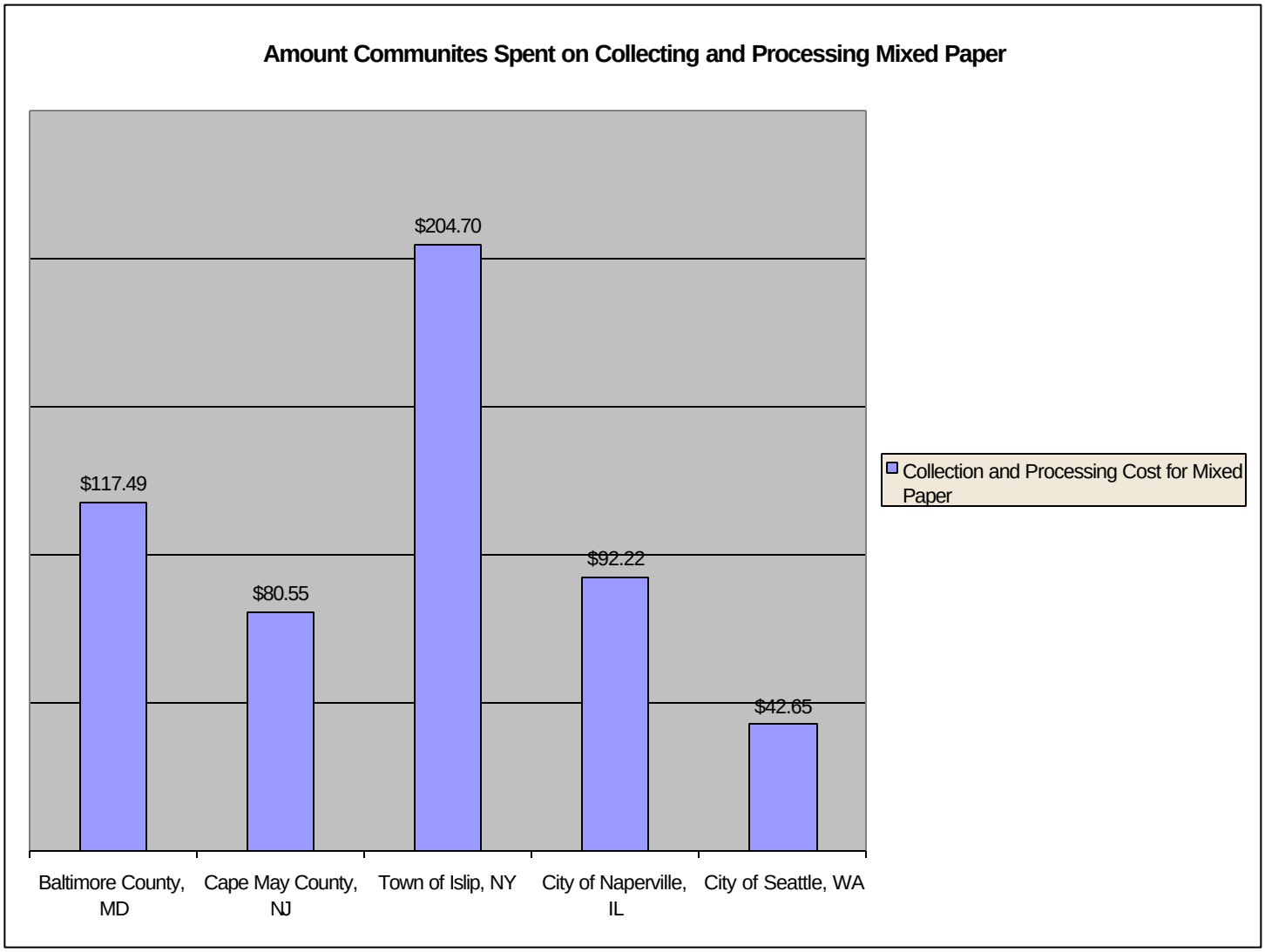
Tables 3.1and the following graph provide data on costs of adding mixed paper for five communities. Per ton cost ranged from $42.65 to $117.49, with an average cost of $107.52.

Table 3.1 Communities collecting mixed paper.

Community	Population Served 1994	Collection Frequency	Vehicle	Crew Size	Container Provided	Set-out System	Mixed Paper Collection and Processing Costs – 1999*
Baltimore County, MD	167,000	Biweekly	Rear-load Packer	2 to 3	No	Kraft Bag, Box or Bundle	$117.49
Cape May County, NJ	74,000	Weekly	Varies	2	No	Kraft Bag, Box or Bundle	$80.55
Town of Islip, NY	76,000	Bi- and Weekly	Rear-load Packer	2 to 3	Yes	20 Gal Round Bin	$204.70
City of Naperville, IL	28,000	Weekly	3 Compart-ment Recycling Vehicle	1	No	Kraft Bag, Box or Bundle	$92.22
City of Seattle, WA	136,200	Weekly	3 Compart-ment Recycling Vehicle	1	Yes	3 Stack Bins	$42.65
			AVERAGE COST				**$107.52**

NOTES
*Costs are dollars per ton. Costs have re-calculated to 1999 dollars.
For more information, please see Gershman (1995).

Figure 3.1 - Mixed Paper Collection Cost



3.3.2 Yard Waste Diversion

Like mixed paper, some communities can benefit by diverting yard waste. The literature identifies two major ways to divert yard waste: home composting and curbside collection. Yard waste can account for as much as 25 percent of the residential waste stream, which places it high among materials that can significantly influence recovery and diversion rates.

Diversion of yard waste can have significant effects on both the refuse and recyclable materials streams. Any community considering diversion of this material will have to consider several issues. These include residential composting versus collection,

capacity to handle yard waste materials, frequency of collection and mandatory versus voluntary diversion.

While a number of communities divert yard waste through backyard composting and "grass-cycling", the majority implement curbside collection programs.
Stevens (1995) examined the relationship between frequency of pick-up, collection costs and diversion. In the programs studied, yard waste collection diverted an average of 13.6 percent of all discards (waste plus curbside recyclable materials plus yard debris) with a range of 1.9 to 26.3 percent. Most programs surveyed, collected yard waste once per week while the second most common collection was weekly during local growing seasons. According to Stevens (1995) collection costs per ton of yard waste collected decreases with the increase of quantity collected at each stop.

Skumatz (1996) lists various ways to divert and process yard waste materials. These include:

- Returning materials as compost to residents at little or no cost.
- Applying the materials to science projects in schools and universities.
- Working with local farms to establish an outlet for compost.
- Community cooperatives which can help to identify outlets.

Skumatz finds that mandatory participation in yard waste collection yielded more diversion than voluntary approaches. In fact, mandatory yard waste programs can increase diversion by five to six percent (1996, 29).

Following is detailed information on the operation and maintenance involved in selected yard waste programs including per ton cost to collect and process the materials. Per ton cost ranged from $10.43 to $137.95, with an average cost of $67.81.

Table 3.3 Communities' Composting Costs

Community	O&M Covers (Annualized capital and O&M)	Composting Cost 1999 (Estimate)
Austin, TX	Municipal high technology co-composing site: temperature testing, turning rows 2 times per week, screen compost.	$89.26
Berkeley, CA	Tipping fee to private high technology facility. Private facility uses tub grinder. Material is watered, screened, windrowed, turned weekly, temperature monitoring and tested.	$137.95
Berlin Township, NJ	Medium technology municipal facility. Windrows are turned once per month.	$10.43
Boulder, CO	Not Available	$62.60
Dakota County, MN	Not Available	$44.05
Fennimore, WI	Medium technology municipal facility. Windrows are turned once per week.	$88.10
King County, WA	Tipping fees to four private contractors with various technologies.	$0.00
La Crescent, MN	Low technology processing (turning of the pile 3-4 times per year). Drop-off is open from April to October.	$40.57
Lafayette, LA	City owned and operated medium technology site. Tub grinding, windrowed and temperature monitored, and reformed.	$131.00
Lincoln Park, NJ	Tipping fee to medium technology County facility.	$24.34
Lincoln, NE	Tub grinding. Windrowed and temperature monitored. Weekly turning.	$46.37
Mecklenburg Cty, NC	Not Available	$0.00
Monroe, WI	Tub grinder rental. At City owned and operated low technology site. Mixing, grinding, 4 turning per year.	$110.13
Naperville, IL	Municipal high technology co-composing site – temperature testing - turning rows 2 times per week – screen compost	$134.48
Newark, NJ	Rental of a screen-all and windrowing of leaves and glass clippings - monthly watering - bi-monthly turning.	$37.10
Perkasie, PA	Not Available	$45.21
San Francisco, CA	Backyard composting program	--
Seattle, WA	Tipping fees to private medium technology facility.	$84.63
Sonoma County, CA	Screening and windrowed	$0.00
Takoma Park, MD	Fall leaves to low technology facility. Bagged leaves and grass clippings to County medium technology site	$117.09
Upper Township, NJ	Not Available	$88.10
Wapakoneta, OH	Not Available	$59.12
West Linn, OR	Grinding and windrowing and turning every 6 weeks at a medium technology site.	$5.80
West Palm Beach, FL	Not Available	$47.53
	AVERAGE COST	**$67.81**

Table Notes
For more information, please see Appendix B or EPA (1994).
Costs have been recalculated to reflect 1999 US dollars and are per ton.
"—" means not applicable.

3.4 IMPLICATIONS FOR MAINE

Suburban communities tend to have a higher percentage of packaging material and yard waste than rural communities. Conversely, an urban community tends to have higher percentages of mixed paper waste. A simple waste stream analysis can help determine what materials should best be targeted.

Waste Stream Analysis

A waste stream analysis should consider the quantity and composition of the waste generated and the level and type(s) of current recycling activities.

Guerra (1992) recommends the following seven steps for setting up an analysis.

1. Define the purpose of the analysis.
2. Estimate costs and review budget constraints.
3. Define the geographical area of the city or county's waste management responsibility.
4. Encourage participation from all those influenced by waste management activities, especially facility operators and haulers.
5. Define categories by which specific waste stream components will be identified and quantified.
6. Develop a sampling method.
7. Conduct the study.

3.5 SUMMARY

- To determine what materials are best diverted from the waste stream, the composition of the current waste stream should be analyzed.

- Most high diversion communities have some type of program designed to divert yard waste. These programs range from voluntary backyard composting to mandatory curbside collection. Communities should consider a range of options.

- Mandatory collection yields higher increases in diversion.

- Communities that target a number of materials tend to have higher diversion rates than other communities. These communities sometimes look to unusual or "minor" materials to increase diversion rates.

- In terms of mixed paper waste, the literature suggests that communities might need to be re-educated about acceptable materials.

3.6 FOR MORE INFORMATION ABOUT RECOVERED MATERIALS

Ashcraft, M. *Something for Nothing Additional Recycling without Additional Cost*. Resource Recycling. 1993.

EPA530-R-92-015. *Waste Prevention, Recycling, and Composting Options: Lessons from 30 Communities* (with Institute for Local Self Reliance). 1994.

Gershman, H. *Collecting Residential Mixed Paper: How Does it Work*. Resource Recycling. October 1995.

Guttman, E. *Recycling to the Max: Targeting and Recovering More Recyclables*. Resource Recycling. August 1995.

Nelson, M. *Collecting Yard Waste Debris More Frequently: Does It Mean Higher Diversion?* Resource Recycling. January 1995.

Jacalone, D. *Curbside Recycling Collection Cost Variables*. Resource Recycling. October 1992.

Pferdehirt, W. et al. *Alternatives Methods for Collection of Residential Recyclables*. Waste Age. March 1993.

Platt, B. Doherty, A. Broughton, C. & Morris, D. *Beyond 40 Percent: Record-Setting Recycling and Composting Programs*. Institute for Local Self Reliance. 1991.

Steuteville, R. *Collecting the Unusual*. Biocycle. July 1992.

Steuteville, R. *Keys to Curbside Efficiency and Performance*. Biocycle. July 1996.

Stevens, B. *Recycling and Yard Debris Collection: State of the Industry*. Resource Recycling. September 1998.

Stevens, B. *Yard Waste Debris: The Relationship Among Collection, Frequency, Cost and Diversion Rates.* Resource Recycling. January 1995.

Tkach, M. *Curbside Recycling Collection: Adding More Materials to the Collection List*. Resource Recycling. April 1995.

Skumatz Economic Research Associates, Inc (SERA). Nationwide Diversion Rate Study - *Quantitative Effects of Program Choices on Recycling and Green Waste Diversion: Beyond Case Studies.* 1996.

4 PROCESSOR DEMOGRAPHICS

4.1 DESCRIPTION OF THE VARIABLES

Processor demographics refer to the characteristics (i.e., public or private) of the intermediate operators that handle recyclable materials between the collectors and end-users.

4.2 KEY QUESTIONS

How are materials handled after collection? What differences exist between private and public processors? Have regional efforts to process materials been successful?

4.3 PROGRAMS, OPTIONS AND POTENTIAL IMPACTS

Most residents believe that recycling ends once recyclable materials have been diverted from the waste stream. Of course, once recyclable materials have been diverted, they have to be processed. Processors prepare recyclable materials for the end-users, including paper dealers, glass manufacturing plants and plastics manufacturers. Processors ultimately are responsible for ensuring that resulting materials are of high quality and that a steady flow of products are directed to end-users.

While most of the costs associated with recycling are found within the “collection” factors, some communities are attempting to realize efficiencies by altering “processing” factors.

When considering processing options, there are several factors to consider; first is public operation versus private or contracted services. There are major advantages/disadvantages to each type of processing.

4.3.1 With PUBLIC processing:

Municipalities incur costs of processing and are responsible for finding markets, unless other levels of government (for example, regional or state level) provide this service.

4.3.2 With PRIVATE or CONTRACTED processing:

Municipalities do not need to oversee the logistics of processing, which minimizes administrative overhead.

Municipalities often pay costs for delivering materials to private facilities, however in some cases they might receive revenue for the recyclable materials. This is dependent of the current market value for various recyclables and the stipulations of any existing contracts with the processing entity.

The EPA (1994) found that about one third of the communities in its study contracted out collection and/or processing services. Additionally, about one third had publicly run operations. [8] They noted several strategies to reduce costs and maximize recovery. For contracted services:

- Make use of competitive bids
- Include local-based organizations in the bidding process
- Retain some portion of the materials revenues
- Base contract on per ton fees, which encourages collectors to increase the materials collected
- Negotiate refuse and disposal contracts that discount for reductions in waste generation

For public programs:

- Maximize participation and tonnage
- Unload as few times as possible
- Create the shortest routes to the processing facilities
- Compaction of materials [9]

Stevens (1998) noted the current "state" of materials processing. She found that 90 percent of recyclable materials from households are delivered to a materials recovery facility (MRF) for processing, as opposed to direct to the market. The average tip fee paid at the MRF was $16 per ton. Furthermore, she noted that communities with high diversion rates tend to have turnkey contracts, where the private firm assumes ownership of the recyclable materials. The high diversion communities were also less likely to require a share of the revenues from the sale of recyclable materials (only 15.4 percent in this group share in revenues, compared to 58.8 percent of the communities with the lowest diversion rates). Private firms operate most MRFs, with just 7.9 percent operated by a government or by a not-for-profit entity (Steven, 1998, 20).

Regional Cooperatives

Depending on the study cited somewhere between 20 and 30 percent of processing centers are not-for-profit regional cooperatives. They exist as nonprofit or public entities. For some communities that do not generate enough material or the correct materials to attract for-profit processors, regional cooperative efforts might be appropriate.

Holmes (1992) indicates that cooperative processing and marketing of recyclable has many advantages. The most direct benefits are the economies of scale obtained from aggregation and a reliable outlet for recyclable materials. Stinnett (1996) lists several strategies to implementing a successful regional effort.

- Identify potential recyclable materials
- Establish a Regional Advisory Committee (RAC)
- Determine regional markets

- Explore export opportunities
- Recruit the recycling industries that match recyclable materials
- Target specific materials for recovery
- Consider cooperative marketing
- Involve the public

Stinnett notes that these strategies, which are helpful for all regions, are best suited for rural communities. Shoenrich and Kohrell (1995) notes that rural communities are finding that cooperative efforts help improve economies of scale, provide more stable markets and facilitate sharing of information. Most important for rural communities are the economies of scale from sharing equipment, facilities, staff, and organizational structures.

Of the regional cooperative efforts currently in place, 32 percent form binding relationships via intergovernmental agreements. Fourteen percent operate under resolution and about 30 percent operate in an informal fashion (Shoenrich and Kohrell, 1995).

4.4 IMPLICATIONS FOR MAINE

With the exception of a few urban centers in Maine, communities do not have the recyclable material generation to operate a processing facility efficiently. For communities interested in creating processing opportunities, regional cooperation should be pursued. Suburban and rural communities especially stand to benefit from regional processing (as well as collection and marketing).

Regionalization can benefit communities in several ways, including providing economies of scale and division of investment and labor. No single community will be fully responsible for the success or failure of the regional effort, the fact of which is appealing on both a political and financial level.

Table 4.1

Community	Per Ton Processing Cost (1999)	Cost Codes	Type of Processing Center (Primary)
Austin, TX	$0.00	A	Private
Berkeley, CA	NA		Private
Berlin Township, NJ	$18.55	B	Public and Private
Boulder, CO	$5.80	C	Private
Bowdoinham, ME	NA	A	NA
Columbia, MO	$0.00		Private
Dakota County, MN	$93.90		Public and Private
Fennimore, WI	$96.22		Public
King County, WA	NA		NA
La Crescent, MN	$120.56	D	Public
Lafayette, LA	NA		Private
Lincoln Park, NJ	NA		NA
Lincoln, NE	$17.39		Private
Mecklenburg Cty, NC	$9.27		Private
Monroe, WI	$52.17		Public
Naperville, IL	$49.85		Private
Newark, NJ	$0.00	A	Private
Perkasie, PA	$11.59		Public
Peterborough, NH	NA		NA
Philadelphia, PA	$9.27	E	Private
Portland, OR	NA		NA
Providence, RI	$37.10	F	Public and Private
San Francisco, CA	$0.00		Private
Seattle, WA	NA		Private
Sonoma County, CA	$0.00		Private
Takoma Park, MD	$16.23	G	Private
Upper Township, NJ	$92.74	H	Public and Private
Wapakoneta, OH	NA		NA
West Linn, OR	$0.00		Private
West Palm Beach, FL	$24.34	I	Public and Private

Source: EPA, 1994.

4.5 SUMMARY

- 80 percent of residential recyclable materials are handled via processing centers.
- One third of communities have public processors, one third of communities have private or contracted processors and one third have a combination.
- Communities that choose internal handling of recyclable materials retain responsibility for costs and revenues associated with processing.
- Only the largest of communities can maintain a processing facility alone.
- Regional efforts provide benefits to communities in a number of ways, including economies of scale.
- Public and non-profit regional efforts are increasingly popular because they are economical, market stabilizing and facilitate communication between municipalities.

4.6 FOR MORE INFORMATION ABOUT PROCESSOR DEMOGRAPIHICS

Berenyi-Brettler, E. *Materials Recovery Facilities: 1997 Update*. Biocycle. September 1997.

Berenyi, E. *Trends in Equipment and Processing*. Biocycle. August 1995.

EPA530-R-92-015. *Waste Prevention, Recycling, and Composting Options: Lessons from 30 Communities* (with Institute for Local Self Reliance). 1994.

Goldstein et al. *The Biocycle Guide to Collection, Processing and Marketing Recyclables*. Biocycle. 1990.

Homles, H. *Cooperative Marketing: In today's recycling markets, there's safety in numbers.* Garbage. May/Jun 1992.

Schmerling, E. *Processing and Marketing Recyclables Cooperatively*. Resource Recycling. February 1996.

Schoenrich, L & Kohrell, M. *Cooperative Marketing Helps Rural Recycling*. Biocycle. February 1995.

Stevens, B. *Recycling and Yard Debris Collection: State of the Industry*. Resource Recycling. September 1998.

Stinnett, D. *10 Steps to Planning a Rural Recycling Strategy*. World Waste. January 1996.

5 MATERIAL PROCESSING

5.1 DESCRIPTION OF THE VARIABLES

Material processing refers to sorting, baling, densifying or otherwise readying the recyclable material for shipment to market.

5.2 KEY QUESTIONS

What are the costs associated with processing recyclable materials? How do these costs vary depending on the state of the material prior to processing, i.e., segregated or commingled?

5.3 PROGRAMS, OPTIONS AND POTENTIAL IMPACTS

The are a wide variety of options for processing materials. These include use of a material recovery facility (MRF) with conveyor driven sorting lines, negative and positive sorts of multiple material types, and various types of balers for specific material types. Smaller transfer station type systems with limited sorting capabilities and one baler for all materials can also be used. A community should select a system that best integrates with their overall program.

5.3.1 Processing Commingled Material

Over the last ten years, there has been a notable trend towards collecting materials commingled at the curb. The most popular commingled option is to provide one set-out system (e.g., bag, and bin) for all containers targeted for collection and another set-out for all fiber materials. These systems are used to increase participation rates by enhancing the program convenience Since in commingled collection systems the materials are not sorted by residents or at collection vehicles, a MRF is required to sort the material, remove contaminants and bale for shipment to market. To achieve economies of scale, MRFs are typically used in cities with populations of more than 50,000.

5.3.2 Processing Source Segregated Material

For drop-off and curbside programs servicing smaller populations, segregation of material prior to collection/or at the drop-off site is the norm. Having participants or collection vehicle personnel segregate materials at the point of collection significantly reduces the level of processing required to prepare materials for shipment to market. For instance, source segregated materials do not have to be put through a sorting line, although the materials will typically need to be consolidated and baled prior to marketing. Similarly, in drop-off programs with compartmentalized receptacles, the materials do not typically require full sorting. However, there may be a need for some quality control at the transfer station or local recycling facility to remove obvious contaminants prior to baling.

5.3.3 Processing Costs

Data is provided in table 5.1 on the per ton costs of processing materials for several communities. These costs range from a low of $9.27 to a high of $120.56. The average cost for the communities with such data is $48.59. While the reasons for the wide range in costs can not be determined, it could result from a variety of factors, including the cost accounting technique used, the range and number of materials processed, the level of automation, and labor hours.

5.4 IMPLICATIONS FOR MAINE

The processing infrastructure in Maine reflects state demographics and the decentralized nature of local programs. Unlike more populous states, Maine's processing infrastructure is not characterized by MRFs servicing large surrounding urban/suburban populations, but rather smaller processing centers with more limited facilities serving smaller populations. Thus, available data on processing costs may not be readily comparable to Maine communities because most of the data is from MRFs with complete sorting and baling systems. Maine's current processing infrastructure would likely preclude the widespread use of commingled collection systems because it currently lacks the means to conduct efficient sorts of multiple materials. Relying on program participants to source segregate materials prior to set out or drop-off will reduce the processing cost, but may also decrease the participation rates by increasing the recycling tasks for residents.

5.5 SUMMARY

- Communities should select a system that best integrates with their overall program, e.g., source segregated programs require limited or no sorting capabilities, commingled programs require MRFs with sorting lines.

- Processing costs vary widely due to such factors as the range and number of materials processed, the level of automation at the facility and labor hours.

- Due to a lack of MRFs in Maine, the state will likely need to continue to design programs where participants source segregate materials prior to collection.

Table 5.1 Selected Communities' Processing Information

Community	Type of Processing Center (Primary)	Materials Processed	Commingled or Segregated	Per Ton Processing Costs (1999)
Berlin Township, NJ	Public and Private	A, F, G, P	Commingled	$18.55
Boulder, CO	Private	A, B, F, G, HP, MP, OCC,ONP	Segregated	NA
Bowdoinham, ME	NA	A, B, F, G, HP, MP, OCC,ONP, P, WG, X	Commingled	--
Columbia, MO	Private	A, F, G, HP, MP, OCC, ONP, P	Segregated	NA
Dakota County, MN	Public and Private	A, F, G, OCC, ONP, P	Segregated	$93.90
Fennimore, WI	Public	A, F, HP,MP, OCC, ONP, P	Segregated	$96.22
King County, WA	NA		NA	NA
La Crescent, MN	Public	A, F, G, OCC, ONP, P	Segregated	$120.56
Lafayette, LA	Private	A, F, G, OCC, ONP, P	Segregated	NA
Mecklenburg Cty, NC	Private	A, F, G, ONP, P	Commingled	$9.27
Monroe, WI	Public	A, B, F, G, HP, M, MP, O, OCC, ONP, P, WG	Commingled	$52.17
Naperville, IL	Private	A, F, G, HP, MP, OCC, ONP, P	Segregated	$49.85
Newark, NJ	Private	A, F, G, M	Commingled	NA
Perkasie, PA	Public	A, G, MP, OCC, ONP	Segregated	$11.59
Sonoma County, CA	Private		NA	NA
Takoma Park, MD	Private	A, F, G ,HP, MP ONP	Commingled	$16.23
Upper Township, NJ	Public and Private	A, F, G, HP, MP, OCC, ONP, P	Commingled	$92.74
Wapakoneta, OH	NA		--	--
West Linn, OR	Private	A, F, G, M, MP, O, OCC, ONP, P	Segregated	$24.34
West Palm Beach, FL	Public and Private	A, F, G, OCC, ONP, P	Commingled	

NOTES: Based on EPA data.
Dollar values represent estimated 1999 costs. In some cases, other governments incur costs.
Dollar values represent estimated 1999 costs. NA = Not Available, " –" Not applicable

MATERIALS KEY A = Aluminum G = Glass OCC = Corrugated Cardboard M = Metal
B = Batteries HP = High Grade Paper P = Plastics MP = Mixed Paper
F = Ferrous cans ONP = Old Newspaper

5.6 FOR MORE INFORMATION ABOUT MATERIALS PROCESSED

EPA530-R-92-015. *Waste Prevention, Recycling, and Composting Options: Lessons from 30 Communities* (with Institute for Local Self Reliance). 1994.

Biddle, D. *MRF Designs Around Single Stream Recycling*. Biocycle. August 1998.

Goldstein et al. *The Biocycle Guide to Collection, Processing and Marketing Recyclables*. Biocycle. 1990.

Halloway, S. *Materials Recovery Facilities Going Strong*. Biocycle. August 1995.

Homles, H. *Cooperative Marketing: In today's recycling markets, there's safety in numbers.* Garbage. May/Jun 1992

Platt, B. Doherty, A. Broughton, C. & Morris, D. *Beyond 40 Percent: Record-Setting Recycling and Composting Programs.* Institute for Local Self Reliance. 1991.

Stevens, B. *Recycling and Yard Debris Collection: State of the Industry*. Resource Recycling. September 1998.

6 EDUCATION AND PUBLICITY

6.1 DESCRIPTION OF THE VARIABLES

Education and publicity refers to communication with the public with the intent of motivating residents to correctly participate in recycling programs.

6.2 KEY QUESTIONS

What is the influence of education and publicity on participation and recovery? What are some of the methods that communities use to communicate with residents?

6.3 PROGRAMS, OPTIONS AND POTENTIAL IMPACTS

The literature universally agrees that some type of education and publicity about a community's recycling program has to take place. Both the EPA (1994) and the ILSR (1991) studies suggest that educational outreach is critical for obtaining high participation rates, especially in urban areas. Divergent ideas can be found about how to effectively implement outreach strategies.

Virtually every survey on public opinion regarding environment finds that nearly everyone thinks recycling is a good thing (Poole, 1992). However, while residents tend to support recycling, they may not have knowledge to effectively participate in a recycling program. Furthermore, residents may have information that is inaccurate and will hinder effective participation and/or recovery. For example, Culter and Moore (1995) find that residents sometimes use "rules of thumb" to make decisions about what materials are recyclable. Their study found that fifty-one percent of the sample sometimes attempts to recycle plastic containers, even if they don't know if the material is recyclable. Twenty-three percent of the sample claimed that they could determine acceptability for recycling by feeling or squeezing the container. This illustrates that re-education is an important component of an effective educational outreach.

Culter and Moore (1995) identify the basic information that should be communicated to residents. This includes:

- Which materials should be set out and which should be excluded
- How to prepare materials (for example, rinsing containers, separating materials and squashing bottles)
- When recyclable materials should be set out for curbside collection
- Where consumers should take materials for drop-off programs
- Why is it important to participate in recycling programs (for example, environmental benefits and cost savings to the community)
- Whom to call for more information

The communities studied by the EPA (1994) used a number of education and publicity techniques including: calendars, flyers, posters, newsletters, articles, print and radio

ads, school curricula, videos, slide shows, demonstrations and exhibits, utility bill inserts, buttons, and telephone hotlines.

The community's demographics will help to determine which outreach methods will be most effective. Cities with transient and diverse populations may face greater challenges in securing broad participation and must typically spend more money on education. Smaller and more homogenous populations may rely on volunteer efforts and word of mouth to ensure high participation rates (EPA, 1994, 68).

Both Goldstein (1990) and the EPA (1994) found that regardless of demographics, targeting school-aged children was an effective way to transmit recycling information to the community. For example, San Bruno, California's elementary school system implemented a recycling curriculum within a Resource Conservation Program. This provided children with basic recycling information and established an environmental consciousness. Education programs directed at school-aged children have been formally and informally implemented (with success) in various communities studied by the EPA.

Finally, as noted in previous chapters, education and publicity can be used to overcome population and socioeconomic barriers to achieving high levels of participation and recovery. Both Folz (1991) and Ligon et al (1996) find that effective education and publicity can help to overcome socioeconomic influences.

POPULATION

Major differences in terms of scale, demographic and public service operations exist between rural, suburban and urban communities. Suburban and rural communities tend to be more homogenous, with most residents living in single family homes (EPA, 1994). Urban communities tend to be more diverse, higher density and have high percentages of commercial and institutional waste. The differences in population and density should be considered with regard to each type of community. These differences will influence the types of education and publicity are needed.

DEMOGRAPHICS

In general, socioeconomic characteristics can influence a portion of diversion and participation rates. It should not be surprising that communities with higher incomes had higher diversion rates.[1] While participation and recovery differs among various communities, Folz (1991) suggests that success is not dependent on upon a community's demographic characteristics. His statistical work confirms the results of the Skumatz (1996) report that community characteristics have some influence on participation and recovery, but he goes further to suggests that this influence is minor. Folz writes, "while community variables [demographics] may be important for predicting citizen preferences for, or a community's ability to afford a particular type of recycling program, they were not important determines of a city's recycling performance" (1991, 531).

6.4 IMPLICATIONS FOR MAINE

For all Maine communities, education and publicity should be central to the recycling program. As Goldstein (1990) suggests, education and publicity have to occur early before changes are made and have to reoccur frequently throughout the program.

Urban communities may need to find more outlets for education and publicity due to their diverse population and demographics. Suburban and rural communities may be able to take advantage of community cohesion and homogeneity with less expansive (and expensive) educational programs. Volunteer efforts and community-based programs will also be more likely in smaller communities.

Educational programs can also be successfully integrated into school curricula. School age children can encourage parents to participate in recycling programs and can use lessons learned at school to help improve material quality and quantity.

6.5 SUMMARY

- Education and publicity are universally accepted as critical to any recycling program.
- Communities with the highest levels of participation and recovery have education and publicity programs.
- The most basic education program should tell residents what, when and where to recycle materials.
- Communities have implemented numerous ways to communicate with residents, from inserts into utility bills to door-to-door outreach.
- Demographics will be a factor in determining what education and publicity programs should be pursued in a community.
- Socioeconomic factors can be overcome with appropriate educational and publicity techniques.

Table 6.1 Selected Communities' Costs for Education and Publicity

Community	Total Education and Publicity Costs (Recycling and Composting) – 1999 - Per Year
Austin, TX	**$52,712.84**
Berkeley, CA	**$32,619.33**
Berlin Township, NJ	**$652.39**
Boulder, CO	**$45,667.06**
Bowdoinham, ME	**$652.39**
Columbia, MO	**$11,286.29**
Dakota County, MN	**$118,734.36**
Fennimore, WI	**$652.39**
King County, WA	**$1,846,190.12**
La Crescent, MN	**$718.93**
Lafayette, LA	**$78,286.39**
Naperville, IL	**$12,395.35**
Newark, NJ	**$117,429.59**
Perkasie, PA	**$968.14**
Peterborough, NH	**NA**
Philadelphia, PA	**$140,915.50**
Portland, OR	**$82,263.34**
Providence, RI	**$2,544.31**
San Francisco, CA	**$378,775.66**
Seattle, WA	**$652,386.59**
Sonoma County, CA	**$7,111.01**
Takoma Park, MD	**$7,828.64**
Upper Township, NJ	**$4,175.27**
Wapakoneta, OH	**NA**
West Linn, OR	**NA**
West Palm Beach, FL	**NA**

For more information, please see ILRS (1990).
Costs are per year and have been re-calculated to 1999 dollars.
NA means Not Available.

Table 6.2 Selected Communities' Education and Publicity Costs for Recycling

Community	Education and Publicity Costs - Recycling Only – 1999 – Per Year
Austin, TX	**$39,665**
Berkeley, CA	**$32,619**
Berlin Township, NJ	**NA**
Boulder, CO	**$45,667**
Bowdoinham, ME	**$652**
Columbia, MO	**$11,286**
Dakota County, MN	**$105,687**
Fennimore, WI	**$652**
King County, WA	**NA**
La Crescent, MN	**$719**
Lafayette, LA	**$65,239**
Lincoln Park, NJ	**$1,305**
Lincoln, NE	**$8,916**
Mecklenburg Cty, NC	**$113,515**
Monroe, WI	**NA**
Naperville, IL	**$9,133**
Newark, NJ	**$93,944**
Perkasie, PA	**$681**
Peterborough, NH	**NA**
Philadelphia, PA	**$140,916**
Portland, OR	**NA**
Providence, RI	**$2,544**
San Francisco, CA	**$328,307**
Seattle, WA	**$260,955**
Sonoma County, CA	**NA**
Takoma Park, MD	**$6,524**
Upper Township, NJ	**$3,914**
Wapakoneta, OH	**NA**
West Linn, OR	**NA**
West Palm Beach, FL	**NA**

For more information, please see ILRS (1990).
Costs are per year and have been re-calculated to 1999 dollars.
NA means Not Available.

6.6 FOR MORE INFORMATION ABOUT EDUCATION AND PUBLICITY

Anderson, P. *Improving the Efficiency of Curbside Recycling Collection*. Resource Recycling. April 1994.

Goldstein, et al. *The Biocycle Guide to Collection, Processing and Marketing Recyclables*. Biocycle. 1990.

Block, D. *Containing Collection Cost*. Biocycle. December 1997.

Culter, A. & Moore, S. *Consumer Education: The Key to Successful Plastics Recycling*. Resource Recycling. May 1995.

EPA530-R-92-015. *Waste Prevention, Recycling, and Composting Options: Lessons from 30 Communities* (with Institute for Local Self Reliance). 1994.

Folz, D. H. & Hazlett, J. M. *Public Participation and Recycling Performance: Explaining Program Success*. Public Administration Review. Nov/Dec 1991.

Ligon, P. Zuckerman, B. & Stutz, J. *Increasing Recovery Rates at the Curb*. Resource Recycling. February 1996.

Platt, B. Doherty, A. Broughton, C. & Morris, D. *Beyond 40 Percent: Record-Setting Recycling and Composting Programs.* Institute for Local Self Reliance. 1991.

Wood, E. *Making Drop-off Recycling Work*. Resource Recycling. January 1996.

CONCLUSION

7 SUMMARY OF SUMMARIES

7.1 Recovery method

- Education and promotion are universally accepted as critical to any recycling program.
- Communities with the highest levels of participation and recovery have strong education and promotion programs.
- The most basic education program should tell residents what, when and where to recycle materials.
- Communities have implemented numerous ways to communicate with residents, from inserts into utility bills to door-to-door outreach.
- Demographics of the community will be a factor in determining what education and promotion programs should be pursued.
- Socioeconomic factor can be overcome will the appropriate educational and promotional techniques.

7.2 Collection frequency

- Weekly collection of recyclable materials can increase participation and recovery rates.
- Communities who already have high participation and recovery rates might be able to reduce costs by implementing biweekly collection.
- To be effective, education and promotion must accompany any changes in collection services.
- Collecting refuse and recyclable materials on the same day does not necessarily improve participation or recovery rates although, both types of collection should be considered.

7.3 Recovered materials

- To determine what materials should be diverted from the waste stream, the composition of the current waste stream should be analyzed.
- Knowledge about the type of waste is generated will help determine what materials can best be diverted.

- Most high diversion communities have some type of program designed to divert yard waste. These programs range from voluntary backyard composting to mandatory curbside collection.

- Communities that target a large number of materials tend to have higher diversion rates than other communities. These communities sometimes look to increase diversion through collection of unusual or minor materials.

7.4 Processor demographics

- 80 percent of residential recyclable materials are handled via processing centers.

- 1/3 of communities have public processors, 1/3 of communities have private or contracted processors and 1/3 have a mixed combination.

- Communities that choose internal handling of recyclable materials retain responsibility for costs and revenues of processing.

- Only the largest of communities can maintain a processing facility alone.

- Regional efforts benefit communities in a number of ways, including economies of scale.

- Public and non-profit regional efforts are increasingly popular because they are economical, market stabilizing and facilitate inter-municipal communication between stakeholders.

7.5 Materials processing

- Communities should select a system that best integrates with their overall program, e.g., source segregated programs require limited or no sorting capabilities, commingled programs require MRFs with sorting lines.

- Processing costs vary widely due to factors such as the types and number of materials processed, the level of automation at the facility, and labor costs.

- Due to a lack of MRFs in Maine, the state will likely need to continue to design programs in which participants source segregate materials prior to collection.

7.6 Education and promotion

- Education and promotion are universally accepted as critical to any effective recycling program.

- Communities with education and promotion programs have the highest levels of participation and recovery.

- The most basic education program should tell residents what, when and where to recycle materials.

- Communities have implemented numerous ways to communicate with residents, from inserts into utility bills to door-to-door outreach.

- Demographics of the community will be a factor in determining which education and promotion programs should be pursued.

- Socioeconomic factors can be overcome with appropriate educational and promotional techniques.

To reiterate the introduction, readers should remember that this report is not a comprehensive guide for improvement. This report addresses seven specific variables of recycling that may or may not be applicable to individual communities. There are at least thirty different variables to consider when implementing or altering a recycling program resulting in thousands of possible combinations and outcomes. To date, no such comprehensive report exists with regards to recycling programs.

As there are no quick fixes or universal best practices for recycling programs, communities are encouraged to make waste reduction and recycling a long-term process. Administrators and coordinators - as well as - communities in general, should view their recycling efforts as always growing and changing. Constant evaluation and re-evaluation are critical.

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[1] In some communities drop-off services accept materials that it are not collected via curbside collection.
[2] Residents who take refuse to the landfill or transfer station could lower fees by diverting recyclable materials.
[3] Communities were determined successful if they achieved an 8 percent diversion rate.
[4] Equipment and personnel issues are also an aspect of curbside collection, but are beyond the scope of this report.
[5] See Block (1997) and Kimrey (1996) for further discussion on biweekly collection of recyclable materials.
[6] Estimated diversion assumes all other variables (in the study) remain constant. It would not be accurate to suggest that only changing collection could increase diversion. A more accurate interpretation would be to suggest the variable "collection frequency" can influence diversion plus or minus two to four percent.
[7] For additional information on container size and collection, see Anderson 1994.
[8] The other third had some combination or private-public partnership.
[9] Private providers can benefit from these strategies as well.